Modern Psychological Studies

Volume 1 | Number 1 Article 9

1992

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Recommended Citation

Ingersoll, Max (1992) "Event frequency estimations for non-semantic items," *Modern Psychological Studies*: Vol. 1 : No. 1 , Article 9.
Available at: https://scholar.utc.edu/mps/vol1/iss1/9

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Event Frequency Estimations For Non-Semantic Items

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ABSTRACT

In order to further clarify the roles of labeling and semantic processing in event frequency encoding, fifty-six undergraduate students were tested on their memory for frequency of sounds. One half of the subjects were presented with familiar sounds (i.e. a telephone ring or wind chimes) and the other half with single musical notes or tones. The use of tones was to defeat the attempts at semantic labeling of the stimuli. It was found that subjects in the familiar sounds condition displayed a significant ability at estimating event frequency. Subjects in the pure tones condition, however, displayed no such ability.

INTRODUCTION

How many times have you been to the movies this year? Chances are, whatever your answer, it will be a close estimation of the actual number. Such memory for event frequency has sparked a good deal of research. Much of this research has focused on supporting or refuting automaticity for event frequency encoding. The criteria for automaticity, according to Hasher and Zacks (1984), include following criteria: (a) requiring no intention other than attention to the stimuli, (b) intention does not increase information encoding, (c) training or direct feedback causes no improvement of encoding, (d) individual differences (i.e. age, education level, social status, motivation levels) have no effect, and (e) distraction due to arousal, stress, or other cognitive demands has no effect (Hasher & Zacks, 1984, p.1373). Greene (1984), however, maintains that frequency encoding is not an automatic process and that intention improves performance. In two experiments, Greene (1984) found that subjects who were informed that they would receive a test on memory for frequency (intentional learning) did better than deceived subjects (incidental learning) in estimating the frequency of occurrence for the words presented. Greene (1984) found that depth of processing played a role in recall of the stimuli. Subjects had to answer yes or no to a semantic orientation question concerning each stimulus. Either a categorical or class relationship was presented (e.g. is an APPLE an animal?) or a letter of the alphabet (e.g. does the letter L appear in the word?) and subjects responded according to class inclusion or letter occurrence. Subjects' performance during recall was significantly better for the stimuli that involved categorical inclusion over letter occurrence.

Watson (1992) also demonstrated the ability of subjects to estimate accurately the frequency of events. His subjects listened to familiar sounds, such as the sound of a lawn mower or a knock on a door, and estimated the frequency of occurrence for each individual sound. Subjects were able to correctly assess the patterns of occurrence, reporting that the sounds presented with the highest rates occurred most often and the sounds that occurred least often were judged to be of the lowest frequency. Subjects were also accurate in their estimates of the actual frequency of occurrence for each sound. Both of theses experiments, like many others, used stimuli that could be semantically processed or labeled, in these cases words and familiar sounds. Other stimuli that have been used include familiar and unfamiliar words, objects, sounds and pictures, all of which contain semantic content (Greene, 1984; Robertson et al. 1992; Watson, 1992).

Our research is concerned with the memory for frequency of stimuli that cannot be labeled semantically. To generate sounds that will defeat semantic processing, we used single musical notes or tones generated on an electronic keyboard. We propose that subjects presented with familiar sounds occurring with various frequencies will be able to estimate accurately the event frequencies. The estimates for the frequency of occurrence of tones, however, will be further from the actual frequency than the estimates for familiar sounds. The use of individual tones should prevent subjects from using semantic or perceptual processing, which will be possible for familiar sounds. This effect of semantic processing would lend support to Greene's (1984) findings against automaticity.

METHOD

Subjects

Fifty-six Ithaca College students enrolled in introductory psychology classes participated. Each subject was tested individually, many received extra credit in their class for being in the experiment.

Materials

Tones were generated using a Yamaha electronic keyboard with in-line recording. Single notes were played one at a time for three seconds, with three seconds between presentations. Familiar sounds were recorded from the Realistic Sound Effects compact disc sound effects sampler. Each sound was recorded for four seconds from the compact disc , with a three second pause between presentations. Both familiar sounds and tones were recorded onto a standard audio cassette.

Procedure

Subject were assigned to one of two conditions, receiving only tones or only familiar sounds as stimuli. For both conditions the instructions, methods of acquisition and testing were the same. The experimenter informed the subjects that their memory for event frequency would be tested and to listen to a subsequently played tape. The acquisition tape consisted of either tones or sounds, on which each frequency occurrence category included two stimuli heard each of 2, 4, 6, or 8 times; there was a total of 40 presentations. Familiar sounds were presented one at a time, each for approximately four seconds, with a three second pause between each. Two untested stimuli occurred at both the beginning and the end of each tape to account for primacy and recency effects; wind chime and water bubbling for the familiar sounds, and the notes A4 and G2 for the tones, as indicated in Table 1.

Table 1

Assignment of Tones and Sounds to Experimental Levels

Stimulus	Note*	Familiar Sound	# of Presentations
1	A2	knife sharpened	4
2	C2	water bubbling	0 (testing tape only)
3	E2	toilet flush	8
4	G2	brushing teeth	1 (recency)
5	B3	spray bottle	4
6	D3	knock on door	8
7	F3	cuckoo clock	6
8	A4	wind chimes	1 (primacy)
9	C4	sawing wood	2
10	E4	lawn mower	0(testing tape only)
11	G4	telephone ring	2
12	B5	typewriter	6

* The tones used are set relative to middle C (C3). The letters indicate the note (A - G) and the numbers indicate the octave the note occurs in.

One minute of Peter Gabriel's song "Shock the Monkey" was played at the end of the acquisition phase to help control for recency effects as well. Tones and familiar sounds were assigned randomly to each of the levels and order of presentation was also randomly assigned.

After administration of the acquisition tape, the experimenter played the testing tape and asked the subjects to estimate the frequency of occurrence for each of the stimuli. The experimenter also informed the subjects that there could be sounds or tones that they had not heard before, and to answer "zero frequency" if this was the case. The testing tape for the tones consisted of the eight tones from the acquisition tape plus two tones that had not been heard, played in order of ascension, going from the lowest note on the keyboard to the highest. The testing tape for the familiar sounds had the eight sounds heard played once, with the addition of two sounds not present during the acquisition phase. Neither tape tested the stimuli used for primacy and recency effects.

RESULTS AND DISCUSSION

As found in previous studies, subjects were able to perceive that some stimuli presented occurred more often than other stimuli, $\underline{F}(4,216)=55.13$, $\underline{p}= .000$.

The type of stimulus, tones or familiar sounds, resulted in a significant effect as well, $\underline{F}(1,54) = 4.77$, $\underline{p} = .033$. Tones received higher estimations than familiar sounds overall, $\underline{M}$ - 4.5 and $\underline{M}$ - 3.9 respectively. while subjects were alert to the zero frequency familiar sounds in the testing phase, $\underline{M}$ 0.0, the estimations for the zero frequency tones were consistently inaccurate, $\underline{M} = 4.05$. Many subjects seemed to respond with an estimate of zero frequency on a seemingly random basis. That any zero frequency responses were given appeared to be related to the instructions given prior to the testing phase that there might be tones that have not been heard on the testing tape. This relationship could be tested by having subjects remain naive to the existence of zero frequency items on the tape.

A significant interaction was also observed between type of sound and the frequency of presentation, $\underline{F}(4,216) = 35.98$, $\underline{p}=.000$. Subjects could estimate the frequency of familiar sounds accurately, as Watson (1992) revealed. With tones, however, subjects' performance, dropped with no clear patterns emerging for their estimates of frequency, as seen in Figure 1.

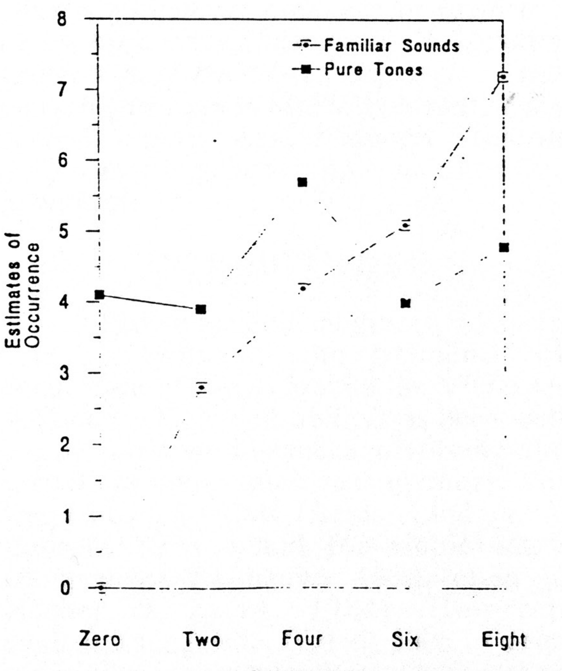

Figure 1. Estimates of the frequency of occurence of familiar sounds and pure tones as a function of actual occurence.

Also of interest were the subjects' reactions to the two different tasks. Subjects tested for tones displayed expressions ranging from exasperation to dismay when asked for frequency estimates, and many appeared to guess blindly. Although some subjects tested for familiar sounds expressed disbelief in their ability to accurately estimate event frequency, their conviction did not compare to that voiced by subjects tested for tones.

In light of these results, at the very least, the automaticity of event frequency processing cannot be said to extend to stimuli that defy easy semantic labeling. A more parsimonious explanation might be that while event frequency encoding may be easy, as demonstrated by the subjects in both the familiar sounds group in this experiment and in Watson's (1992), it becomes increasingly difficult as cues for semantic labeling are removed. This explanation would account for Greene's (1984) findings that depth of processing had a positive effect on recall. As subjects increased their processing of stimuli, more cues could be identified and accessed (i.e. categorical inclusion or exclusion) and be used to aid in retrieval. The limitations of pure tones to cues of frequency (pitch) and amplitude (relative volume) left subjects with little information for semantic labeling. The number of cues was reduced even further during the experiment by keeping the amplitude constant for each tone.

To test the hypothesis that an abundance of cues aids in memory for event frequency, the tones could be given more cues than the sound frequency used in this experiment. Additional cues such as amplitude (the relative loudness) or complexity of the tones could be supplied. If the number of cues does aid in recall, then subjects presented with harmonic chords of varying volumes should give more accurate estimates of event frequency than the subjects tested for tones in this experiment. Anchoring the tones by playing all the stimuli prior to the acquisition phase could also aid in recall by providing semantic labels oriented around position (i.e. first tone, second tone, etc.).

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